Stated Meeting, May 20, 1870.

Present, ten members.

Mr. Fraley, Vice-President, in the Chair.

A letter accepting membership was received from Maj. R. E. Williamson, dated San Francisco, May 10th, 1870.

A letter respecting the Byington MSS. was received from Prof. Jos. Henry, Sec'y Smithsonian Institute, Washington, D. C., May 16th.

Donations for the Library were received from the Academies at Turin, Berlin and Boston; the Annales des Mines, and Nature; the R. Astronomical Society; Essex Institute; Boston Public Library; Silliman's Journal; American Museum of Natural History in New York, and Dr. Wm. Duncan, of Savannah.

The death of Dr. Jas. Y. Simpson, of Edinburgh, was announced by the Secretary.

ON THE GEOLOGICAL AGE AND EQUIVALENTS OF THE MARSHALL GROUP.

By Prof. A. Winchell,

Director of the Geological Survey of Michigan..

Part II.[112]

IV. Present State of our Paleontological Knowledge.

I come now to the most important and most interesting branch of this investigation. In order that others may be placed in full possession of all

[112] For Part I of this paper, see Proceedings American Philosophical Society, vol xi., p, 57 (March 5, 1869). Both Parts of the paper were presented to the Chicago meeting of the American Association for the Advancement of Science, August 11, 1868. It was not offered for publication in the Proceedings in consequence of its length. It was reported, however, in the Chicago newspapers, and the chief points were briefly stated in the *American Naturalist* for October, 1868, p. 445. Part I. was published in these "Proceedings" without alteration; and Part II., as here presented, is unchanged, except in the omission of some detailed lists of fossils, and in the addition of a few remarks based on late discoveries in Tennessee and Pennsylvania, and which have been made public in these Proceedings, vol. xi., p. 245, etc.

the data upon which my forthcoming conclusions are to rest, I introduce here a complete list of the fossils of the Marshall Group, and its supposed equivalents in other States. As introductory to this, however, and as tending to exclude from consideration the series of shales which I have designated the Huron group, I offer a few remarks upon the paleontology of these strata as far as investigated.

The following is a complete catalogue of the fossils thus far determined:

Orthoceras Barquianum. Win.
Spirifera subattenuata, Hall.
" medialis, Hall.
" Huronensis, Win.
" pharovicina, Win.
" insolita, Win.
Retzia polypleura, Win.
Merista Houghtoni, Win.
Pleurotomaria Huronensis, Win.
Goniatites Whitei, Win.
Rhynchonella Huronensis, Win.
Orthis Vanuxemi, Hall.
" crenistria? Phil.
" Iowensis? Hall.
Chonetes setigera? Hall.
Cardinia complanata, Win.
Leptodomus clavatus, Win.
Solen priscus, Win.
Orthoceras gracilius, Win.

Four of the foregoing species I have identified, more or less doubtfully, with species from the Hamilton group. These are *Spirifera subattenuata*, *S. medialis*, *Orthis Vanuxemi*, and *O. Iowensis*. A species very similar to *O. Vanuxemi* exists, however, in the Waverly series of Ohio, and in strata of the same age in Illinois and Missouri. *Chonetes setigera (?)* of the list, ranges in New York from the Marcellus shale to the Genesee. *Leptodomus clavatus* closely resembles a *Grammysia*, a genus ranging from the Corniferous to the Chemung. The equivalencies of these rocks are not very precisely indicated from the paleontological data. That the formation is newer than the Genesee shale is demonstrated by its observed superposition. The paleontological evidence indicates, at least, that the fauna is older than that of the Marshall group; and this is all that is necessary. If this group of rocks is proven by stratigraphical superposition to be newer than the Genesee, it belongs either to the horizon of the Portage and Chemung, or to that of the Marshall. If its stratigraphical position, its lithological characters and its fossil remains indicate equally that it is not to be embraced in the same group with the Marshall, no alternative remains. *The Huron group, above the Black Shale, must correspond to the Portage and Chemung, or to some portion of them.*

The question is now narrowed down to this:—Having discovered a representative of the Portage and Chemung groups in the Huron shales and their equivalents, in Michigan and Ohio, ought we to unite with these shales the Marshall sandstones and their equivalents, and thus embrace these also in the zone of the Portage and Chemung?

I have furnished lithological and stratigraphical indications that this ought not to be done. Let us examine the paleontological evidence.

CATALOGUE OF THE KNOWN FOSSILS OF THE MARSHALL GROUP AND ITS SUPPOSED EQUIVALENTS IN THE UNITED STATES.[113]

Names.	References.	Mich. N.	Mich. S.	Ohio.	Ind.	Ill.	Iowa.	Mo.	Other States.
Spirophyton crassum, Hall	xvi. Rep. N. Y. Reg., 83		*	*				*	
Dictyophyton Newberryi, Hall	xvi. Rep. N. Y. Reg., 87			*					
" Redfieldi, Hall	xvi. Rep. N. Y. Reg., 88			*					
Lepidodendron corrugatum, Daw.	Qr. Jour. Geol. Soc. xviii. Pl. xii., fig. 10.			*					
" sp ?		*							
Sigillaria sp ?	Proc. A. P. Soc., xii., 260			*					
Syringodendron gracile, Daw.	Qr. Jour. Geol. Soc., xviii. Pl. xii., fig. 12.			*					
Lycopodites gracilis, Shum. sp.	Mo. Rep. II., 208, Pl. A, 11							*	
Rhachiopteris striata, Daw.	Qr. Jour. Geol. Soc., xviii.			*					
Cyclopteris ? Marshallensis, Win.	MS.		*						
Nullipora obtexta, White	Bos. Proc., ix., 33						*		
Lophophyllum calceola, W. & W.	Bos. Proc., viii., 305						*		
Zaphrentis elliptica, White	Bos. Proc., ix., 31						*		
" acutus, W. & W.	Bos. Proc., viii., 306						*	*	
" Ida, Win.	Phil. Pr., July, 1865, p. 111			*	*				Tenn
Sphenopoterium enorme, M. & W.	Phil. Pr., Oct., 1860, p. 448				*	*		*	
Conopterium effusum, Win.	Phil. Pr., July 1865, p. 111							*	
Syringopora Harveyi, White	Bos. Proc., ix., 32						*		
Alveolites vermicularis, McCoy	Brit. Cal. Fos., 1st Fasc. 69 Mo. Rep. viii., 218							*	
Favosites divergens, W. & W.	Bos. Proc., viii., 306						*		
" (?) mancus, Win.	Phil. Pr., July, 1865, p. 112								
Leptopora typa, Win.	Phil. Pr., Jan., 1863, p. 3						*		
Trematopora (?) vesiculosa, Win.	Phil. Pr., Jan., 1863, p. 3			*			*		
" (?) fragilis, Win.	Phil. Pr., Jan., 1863, p. 3						*		
Synbathocrinus Owenii, Hall	xiii. Rep. N. Y. Reg., 111								
Pentremites Rœmeri, Shum.	Mo. Rep., II., 186							*	
" sp ?				*					
? Onychocrinus exculptus, Ly. & Cas.	Amer. Jour. [2] xxix., 78								
Platycrinus graphicus, Hall	Pamph. 11 Nov. 1863; xvii Reg. Rep., 54								Ky.
" contritus, Hall	" " " " 54			*					
" sp ?				*					
Actinocrinus Indianensis, Ly. & Cas.	Am. Jour. Sci. [2] xxix., 75							*	
" pistilliformis, M. & W.	Phil. Pr., Aug. 1865; Ill. Rep., III., 151					*			
" Coreyi, Ly. & Cas.	Am. Jour. Sci. [2] xxix., 76								
" Helice, Hall	Pamph. 11 Nov. 1863; xvii. Reg. Rep., 53								
" viminalis, Hall	" " " " 54			*					
" Daphne, Hall	" " " " 52			*					
" sp ?				*					
Bursacrinus Meekianus, Shum.	Mo. Rep., II., 188					*		*	
Cyathocrinus decadactylus, Ly. & Cas	Am. Jour. Sci. [2] xxix., 73								
" hexadactylus, Ly. & Cas.	" " " 74				*				
Poteriocrinus crineus, Hall	Pamph. 11 Nov. 1863; xvii. Reg. Rep., 56			*					
" Pleias, Hall	" " " " 57			*					
" Corycia, Hall	" " " " 57			*					
Forbesiocrinus communis, Hall	" " " " 55			*					N. Y.
" lobatus, *var.* tardus, Hall	" " " " 56			*					
" Kellogi, Hall	" " " " 56			*					
Scaphiocrinus (Poteriocrinus) Ægina Hall	" " " " 57			*					
" " Lyriope, Hall	" " " " 58			*					
" subcarinatus, Hall	" " " " 58			*					
" subtortuosus, Hall	" " " " 59			*					
Zeacrinus paternus, Hall	" " " " 59			*					
" Merope, Hall	" " " " 60			*					
Lepidechinus rarispinus, Hall	xx. Rep. N. Y. Reg., 295			*					Pa.

[113] This Catalogue is little more than a list of references to the original descriptions. There is undoubtedly a large amount of synonymy involved, but extended investigation will be required to eliminate it satisfactorily. The Catalogue, in its present form, will be found useful, it is hoped, to all occupied with researches in rocks of this age.

NAMES.	References.	Mich. N.	Mich. S.	Ohio.	Ind.	Ill.	Iowa.	Mo.	Other States.
Fenestella rhombifera, Phil.	} Mo. Rep., 218							*	
" sp?	}							*	
Lingula membranacea, Win.	Phil. Proc., Jan. 1863, p.3						*		Pa.
" Melie, Hall	xvi. Rep. N. Y. Reg., 24			*					
" Cuyahoga, Hall	" " " 24		*	*					
" ? subspatulata, M. & W.	Ill. Rep., III., 437			*					Tenn
Discina capax, White	Bos. Proc., ix., 30, (1862)			*			*		
=*D. Newberryi*, Hall	xvi. Rep. N. Y. Reg., 30, (1863.)								
" Gallaheri, Win.	Phil. Pr. July, 1865, p. 112		*	*					Pa.
" patellaris, Win.	" Jan., 1863, p. 4						*		
" Saffordi, Win.	Tenn. Rep., 1869, p.443; } Proc. A. P. Soc., xii., 248 }								Tenn
Producta arcuata, Hall	Iowa Rep., 518			*			*		
" concentrica, Hall	x. Rep. N. Y. Reg., 180	*	*	*	*		*		Tenn
" Cora, d'Orb.	Pal. Voy. en Amer. mer. 55			*					
" Cooperensis, Swal.	St. Louis Trans., I., 640			*			*	*	
" crenulata, Shum.	Mo. Rep., 218							*	
" curtirostra, Win.	Phil. Proc. July, 1865, p. 114						*		
" dolorosa, Win.	" " " 114			*					
" duplicostata, Win.	" " " 113		*	*					
" gracilis, Win.	" " " 112			*					
" lævicostata, White	Bos. Jour., vii., 230						*		
" minuta, Shum.	Mo. Rep., 218							*	
" morbilliana, Win.	Phil. Proc., July 1865, p.113			*			*		
" Murchisoniana, de Kon.	} Genus Prod. Pl. xvi., 3 } Mo. Rep., 218					*		*	
" Newberryi, Hall	x. Rep. N. Y. Reg., 180			*					
? = *P. semireticulata*, Flem.									
" parvula, Win.	Phil. Proc., Jan. 1863, p. 4						*		
" pyxidata, Hall	Iowa Rep. Part II. p. 498					*		*	
" semireticulata, (Flem.) de Kon.	Monogr. Gen. Prod., 183		*	*		*	*		Pa.
" Shumardiana, Hall	Iowa Rep. Part II. p. 498			*				*	
" subaculeata, Murch.	Bull Geol. Soc., xi., 255							*	
Strophalosia ? nummularis, Win.	Phil. Proc., Jan. 1863, p. 4						*		
Chonetes Fischeri, Nor. & Prat.	Phil. Jour., III., 25						*		Tenn
" geniculata, White	Bos. Proc., ix., 29			?	?		*	*	
" Illinoisensis, Worthen = *C. Logani*, Hall, (not Nor. & Prat.)	St. Louis Trans., I., 571	*		*	*		*		
	Iowa Rep. Part II., p. 598								
" Logani, Nor. & Prat.	Phil. Jour., III., 30. Pl. II., fig. 12			*			*		
" mesoloba, Nor. & Prat.	Phil. Jour., III., 27			*					
" Michiganensis, Stevens	Am. Jour. Sci. [2] xxv. 262		*						
" multicosta, Win.	Phil. Proc., Jan. 1863, p. 5						*		Tenn
" ornata, Shum.	Mo. Rep., II., 202							*	
" pulchella, Win.	Phil. Proc., Sept. 1862, 410		*	*					Pa.
" Shumardiana, de Kon.	Monogr. 1re. part. p. 192								Ky.
Strophomena rhomboidalis, Wahl.	Act. Soc. Upsal., III, 65			*		*	*	*	
? Strophodonta arctostriata, Hall	N.Y. Rep. IVth Dist., 266			*					N. Y.
Hemipronites inæqualis, Hall, sp.	Iowa Geol. Rep., II., 490			*			*		Pa.
" inflatus, W. & W.	Bos. Proc., viii., 293			*			*		
" lens, White	Bos. Proc., ix., 28			*		*		*	
" ? umbraculum, (V. B.)	Anim. Foss., 222			*			*	*	Pa.
Orthis flava, Win.	Phil. Proc., July 1865, p.117						*		
" Michelini, L'Evéillé, sp.	Mem. Geol. Soc., France, II., 39			*		*		*	Pa.
" Missouriensis, Swal.	St. Louis Trans., I., 639							*	
" occasus, Hall	xiii. Rep. N.Y. Reg., p. 111				*				
" resupinata, Phil.	Pal. Foss., Cornwall, 67					*		*	
" subelliptica, W. & W.	Bos. Proc., viii., 292			*			*		
" Swallovi, ? Hall	Iowa Rep. Part II., 597						*		
" Thiemei, White	Bos. Jour., vii., 231						*		
? " Vanuxemi, Hall	x. Rep. N. Y. Reg., 135			*			*		
Spirifera biplicata, Hall	Iowa Rep., 519			?		*	*		
" camerata, Morton	Am. Jour. Sci. [1] xxix. 150			*					
" Carteri, Hall = *S. Vernonensis*, Swal.	x. Rep. N.Y. Reg. 170 (1858)			*		*	*		Pa.
" centronota, Win.	Phil. Proc., July 1865, p.118			*					
" Cooperensis, Swal.	St. Louis Trans., I., 643; Ill. Rep., II., 155				*			*	

Names.	References.	Mich. N.	Mich. S.	Ohio.	Ind.	Ill.	Iowa.	Mo.	Other States.
Spirifera Cooperensis, Swal.									
= *S. semiplicatus*, Hall	xiii. Rep. N. Y. Reg., 111								
? " cuspidata, Sow. (not Hall)	Min. Conch., III., 42							*	
" extenuata, Hall	Iowa Rep., 520		*	*			*		
" Grimesi, Hall	Iowa Rep., 604					*			
" hirta, W. & W.	Bos. Proc., viii., 293						*		Tenn
" latior, Swal.	St. Louis Trans., II., 86							*	
" lineata, Phil.	Geol. Yorks., II., 219							*	
" Marionensis, Shum.	Mo. Rep., II., 203			*				*	
? = *S. Vernonensis*, Swal.									
" Missouriensis, Swal.	St. Louis Trans., I., 643							*	
? " mucronata, Con.	Ann. Rep. N.Y. 1841, p.54							*	
	Hall: N.Y.Rep.IVth Dist								
" Osagensis, Swal.	St. Louis Trans., I., 641							*	
? = *S. Carteri*, Hall									
" peculiaris, Shum.	Mo. Rep., II., 202					*	*	*	
" Sillana, Win.	Phil.Proc.,July 1865,p.119			*					
? " striata, Sow.	Min. Conch., III., 125							*	
" subrotundata, Hall	Iowa Rep. Part II., 521			*			*		
" Taneyensis, Swal.	St. Louis Trans., I., 645							*	
" texta, Hall	x. Rep. N.Y. Reg., 169				?				
" Waverlyensis, Win.	Proc. A. P. Soc., xii., 251			*					
" (Cyrtia) Hannibalensis, Swal.	St. Louis Trans., I., 648							*	
Cyrtia acutirostris, Shum.	Mo. Rep., II., 204							*	
" sp?				*					
Syringothyris typa, Win.	Phil. Proc., Jan.1863, p. 7			*		?	*		Pa.
" Halli, Win.	Phil. Proc., Jan. 1863, p. 8		*				*	*	
" capax, Hall, sp.	Iowa Rep. Part II., 520						*		
Spiriferina binacuta, Win.	Phil.Proc.,July 1865,p.120						*		
" Clarkesvillensis, Win.	Phil.Proc.,July 1855,p.119							*	
" solidirostris, White	Bos. Jour., vii., 232			*			*		
Spirigera biloba, Win.	Phil.Proc.,July 1855,p.119				*				
" corpulenta, Win.	Phil. Proc., Jan. 1863, p. 6						*		
" crassicardinalis, Swal.	Bos. Jour., vii., 229						*		
" Hannibalensis, Swal.	St. Louis Trans., I., 649			*		*	*		
" Missouriensis, Win.	Phil.Proc.,July 1865,p.117			*				*	
" Ohiensis, Win.	" " " 118			*					
" Prouti, Swal.	St. Louis Trans., I., 649					*		*	
Nucleospira Barrisi, White	Bos. Jour., vii., 227						*		
Retzia Osagensis, Swal.	St. Louis Trans., I., 653							*	
" (?) Popeana, Swal.	St. Louis Trans., I., 654							*	
" sexplicata, W. & W.	Bos. Proc., viii., 294						*		
" (Acambona?) altirostris, White	Bos. Proc., ix., 28						*		
Atrypa sp?	Mo. Rep., 218							*	
Ambocœlia sp?				*					
" (Spirifera?) minuta, White	Bos. Proc., ix., 26					*		*	
Pentamerus Salinensis, Swal.	St. Louis Trans., I., 652							*	
" lenticularis, W. & W.	Bos. Proc., viii., 295						*		
Rhynchonella Barquensis, Win.	Phil. Proc.,Sep.1862, p.408	*							
" camerifera, Win.	" " " 408	*							
" caput-testudinis, White	Bos. Proc., ix., 23						*		
" Cooperensis. Shum.	Mo. Rep., II., 204						*	*	
" gregaria. Shum.								*	
" heteropsis, Win.	Phil.Proc.,July 1865,p.121			*			*		
" Hubbardi, Win.	" Sep. 1862, p. 407	*	*	*					
" Marshallensis, Win.	" " " 408		*	*					
" Missouriensis, Shum.	Mo. Rep., II., 204; Ill. Rep.,II.153; Ib., III. 450			*	*	*	*	*	
" obscuroplicata, Shum.	Mo. Rep., 218							*	
" occidentalis, Shum.	" 218							*	
" opposita, W. & W.	Bos. Proc., viii., 294						*		
" persinuata, Win.	Phil.Proc.,July 1865,p.121						*		
" pustulosa, White	Bos. Jour., vii., 226			*			*		
" Sageriana, Win.	Phil. Proc.,Sep. 1862,p.407		*	*					Tenn
" subcircularis, Win.	" " " 408		*						
" ? tetraptyx, Win.	" July 1865, 120				*				
" unica, Win.	" " " 122						*		
" Whitei, Win.	" Sep. 1862, 407		*						
" (Retzia?) micropleura, Win.	" July 1865, 122		*						
" (Eatonia) obsolescens, Hall	xiii. Rep. N. Y. Reg., 111				*				
Centronella Allei, Win.	Phil.Proc.,July 1865,p.123			*		*	*		
" Flora, Win.	Pr.Am. Phil. Soc., xii.,254			*					

Names.	References.	Mich. N.	Mich. S.	Ohio.	Ind.	Ill.	Iowa.	Mo.	Other States.
Centronella Julia, Win.	Phil. Proc.,Sep. 1862,p.405	*							
Terebratula Burlingtonensis. White	Bos. Jour., vii., 228						*		
? " fusiformis, Murch. & V.	Geol. Russ., p. 65							*	
Ostrea patercula, Win.	Phil.Proc.,July 1865,p.124						*		
Pterinea cardinata. Win.	Phil.Proc.,Sep. 1862,p.412	*							
" crenistriata, Win.	" July 1865, p. 124		*						
=*Cardiopsis crenistriata*,Win	" Sep. 1862, p. 417								
" spinalata, Win.	" July 1865, p. 124			*			*		
" strigosa, W. & W.	Bos.Proc., ix., 31						*		
" ? undulata, M. & W.	Ill. Rep., III., 456					*	*		
" Whitei. Win.	Phil. Proc., Jan. 1863			*			*		
Aviculopecten Caroli, Win.	" " p. 9			*			*		
" circulus, Shum., sp.	Mo. Rep., II., 206							*	
? " duplicatus, Hall	N. Y. Rep., 264							*	N. Y
" gradocostatus, White	Bos. Proc., ix., 31						*		
" Newarkensis, Win.	Proc.A. P. Soc.,Jan. 1870, xii., 255			*					
" nodocostatus,W.& W.	Bos. Proc., viii., 296						*		
" occidentalis, Win.	Phil. Proc., Jan. 1863, p. 9			*			*		
" tenuicostatus, Win.	" " 10		*	*	*		*		
Pernopecten limæformis, Win.	" July 1865, p.126			*			*		
=*Aviculopecten limæformis*, W. & W.	Bos. Proc., viii., 295								
" limatus, Win.	Phil.Proc.,July 1865,p.126			*			*		
" Shumardanus, Win.	" " 126; Ill. Rep., III., 453						*		
" ? (Amusium) Cooperensis, Shum.	Mo. Rep., II., 206							*	
Microdon reservatus, Hall	Prelim.Notice,part 2,p.33			*			*	*	
Posidonomya ambigua, Win.	Phil. Proc., Jan. 1863,p.10			*			*		
" mesambonata, Win.	" Sep. 1862, p. 420		*						
" Romingeri, Win.	" " " 420		*						
" Whiteana, Win.	" " " 420		*						
Dexiobia Whitei, Win.	" Jan. 1863, p. 11						*		
=*Cardiomorpha orata*, Hall	Iowa Rep., part 2, p. 522								
+*C. parvirostris*, Whlte	Bos. Proc., ix., p. 31								
" Halli, Win.	Phil.Proc.,Jan. 1863, p.11						*		
Pinna (?) Marshallensis,. Win.	" July 1865, p. 126		*						
Mytilus elongatus, Shum	Mo. Rep., 218							*	
" fibristriatus, W. & W.	Bos. Proc., viii., 296						*		
=*Mytilarca fibristriata*, Hall	Prelim.Notice,part 2, p.24								
" occidentalis, W. & W.	Bos. Proc., viii., 297						*		
=*Mytilarca occidentalis*, Hall	Prelim.Notice, part 2,p.24								
" Whitfieldanus, Win.	Phil. Proc.,Sep. 1862, p.413	*	*				*		
=*Mytilarca fibristriata*, Hall	Prelim.Notice,part 2,p. 24								
Myalina imbricaria, Win.	Phil. Proc., Sep. 1862,p.412		*						
" Iowensis, Win.	" July 1865, p. 127						*		
" Michiganensis, Win.	" Sep. 1862, p. 411		*						
" pteriniæformis, Win.	" " " 412	*							
" rara,[114] Win.	Proc. A.P. Soc. (hoc loco)		*						
=*M. aviculoides*, Win.	Phil.Proc.Sep. 1862, p. 412								
Orthonota phaselia, Win.	" Jan. 1863, p. 12						*		
" rectidorsalis, Win.	" Sep. 1862, p. 412		*						
" ventricosa, W. & W.	Bos. Proc., viii., 297						*		
Sanguinolites amygdalinus, Win.	Phil. Proc.,Jan. 1863, p. 13						*		
=*Modiomorpha (?)amygdalina*, Hall	Prelim.Notice,part 2,p. 78								
" Æolus, Hall	" " 46			*					
" borealis, Win.	Phil.Proc.,Sep. 1862, p.415	*	*						
" concentrica, Win.	" July 1865, p. 128		*						
=*Cardinia concentrica*, Win.	" Sep. 1862, p. 413								
" cylindricus, Win.	" Jan. 1863, p. 13						*		
" ? flavius, Hall	Prelim.Notice,part 2,p.47								
" Iowensis, Win.	Phil.Proc., Jan. 1863, p.14						*		
" ? jejunus, Win.	" " 15						*		
" Marshallensis, Win.	" Sep. 1862, p. 415		*	*					
" naiadiformis, Win.	Proc. A. P. Soc., xii., 255		*	*					
" strigatus, Win.	Phil.Proc.,July 1865,p.127	*							
" sulciferus, Win.	" Jan. 1863, p. 14						*		
" umioniformis, Win.	" Sep. 1862, p. 414		*						
" valvulus, Hall	Prelim.Notice,part 2,p.46			*					

[114] The original name (*M. aviculoides*) is preoccupied by Meek & Hayden, for a Permian species.

Names.	References.	Mich. N.	Mich. S.	Ohio.	Ind.	Ill.	Iowa.	Mo.	Other States.
Sanguinolites (Cypricardia ?) Chouteauensis, Swal. sp.	St. Louis Trans., I., 96							*	
" " rigida, W. & W. sp.	Bos. Proc., viii., 300			*			*		
" " rhombea, Hall	N. Y. Rep., p. 291								N. Y.
" " securis, Win.	Proc. A. P. Soc., xii., 255			*					
" (Cypricardia) ventricosa, Hall. sp.	xiii. Rep. N. Y. Reg., 110				*				
Allorisma Hannibalensis, Shum.	Mo. Rep. II., 206		*	*			*	*	N. Y.
= *Grammysia Hannibalensis*, Hall	Prelim. Notice, pt. 2, p. 62								
Edmondia æquimarginalis, Win.	Phil. Proc., Sep. 1862, p. 413		*	*			*		N. Y.
" binumbonata, Win.	" " 414		*						
" Burlingtonensis, W. & W.	Bos. Proc., viii., 301			*			*		
" contracta, Win.	Phil. Proc., July 1865, p. 110						*		N. Y.
= *Cypricardia contracta*, Hall	N. Y. Rep. IVth Dist. p. 292								
= *Edmondia? bicarinata*, Win	Phil. Proc., Jan. 1863, p. 13								
= *Sanguinolites rigida*, Hall	Prelim. Notice, part 2, p. 44, (1870)								
" elliptica, Win.	Phil. Proc., Jan. 1863, p. 13						*		
" Marionensis, Swal.	St. Louis Trans., I., 654							*	
" nitida, Win.	Phil. Proc., Jan. 1863, p. 12						*		
" nuptialis, Win.	" " 12						*		
" strigillata, Win.	" " 12						*		
Modiomorpha hyalea, Hall	Prelim. Notice, part 2, p. 79			*					
Cardiomorpha Julia, Win.	Phil. Proc., Sep. 1862, p. 416		*						
" modiolaris, Win.	" 416		*						
" sulcata, de Kon.	Anim. Foss., 109							*	
" triangularis, Swal.	St. Louis Trans., I., 655							*	
" trigonalis, Win.	Phil. Proc., Jan. 1863. p. 15						*		
? = *C. rhomboidea*, Hall	Iowa Rep., part 2, p. 523								
Pholadella Newberryi, Hall	Prelim. Notice, part 2, p. 65			*					
Arca arguta, de Kon.	Anim. Foss., p. 116							*	
" Missouriensis, Shum.	Mo. Rep., 218							*	
" modesta, Win.	Phil. Proc., Jan. 1863, p. 15			*			*		
" sp ?	Mo. Rep., 218							*	
Macrodon cochlearis, Win.	Phil. Proc., Jan. 1863, p. 16						*		
" ovatus, Hall	Prelim. Notice, part 2, p. 15			*					
" parvus, W. & W.	Bos. Proc., viii., 299						*		
Ctenodonta bellaluta, Win.	Phil. Proc., July 1865, p. 128							?	N. Y.
= *Nucula bellatula* Hall	N. Y. Rep. IVth Dist., p. 196								
" hians, Win.	Phil. Proc., July 1865, p. 128				*				
= *Nucula hians*, Hall	xiii. Rep. N. Y. Reg., p. 110								
" Houghtoni, Win.	Phil. Proc., July 1865, p. 128		*						
= *Nucula Houghtoni*, Stev.	Am. Jour. Sci. [2] xxv., 262								
" Hubbardi, Win.	Phil. Proc. Sep. 1862, p. 417; July 1865, p. 128		*	*					
? = *Nuculites sulcatina*, Con.	Phil. Jour., viii., p. 250								
" Iowensis, Win.	Phil. Proc., July 1865, p. 128		*				*		
= *Nucula Iowensis*, W. & W.	Bos. Proc., viii., 298; Win. Phil. Proc., Sept. 1862, p. 418								
" microdonta, Win.	Phil. Proc., Jan. 1863, p. 16						*		
" sectoralis, Win.	" Sep. 1862, p. 418	*	*	*					
? = *Nuculites mactroides*, Con	Phil. Jour., vii., p. 249								
" Stella, Win.	Phil. Proc., Jan. 1863, p. 419	*	*	*					
Nuculana (Leda) bellistriata, Stevens, sp.	Am. Jour. Sci. [2] xxv., 261 Win. Phil. Proc., Sep. 1862, p. 419		*						Tenn
" " Barrisi, W. & W., sp.	Bos. Proc., viii., 298			*				*	
= *Palæaneilo Barrisi*, Hall	Prelim. Notice, part 2, p. 11								
" (Leda) dens-mammillata, Stevens, sp.	Am. Jour. Sci. [2] xxv., 261		*						
" " nuculæformis, Stevens, sp.	" " " 261		*						
" " pandoræformis, Stevens, sp.	" " " 261		*						
" " saccata, Win.	Phil. Proc., Jan. 1863, p. 16							*	
Palæaneilo attenuata, Hall	Prelim. Notice, part 2, p. 12			*					
Conocardium bovipedale, Win.	Phil. Proc., Sep. 1862, p. 419		*						
" Napoleonense, Win.	" " 419		*						
" pulchellum, W. & W.	Bos. Proc., viii., 299			*				*	
" Romingeri, Win.	MS.		*						
Isocardia ? Jennæ, Win.	Phil. Proc., Jan. 1863, p. 17							*	

Names.	References.	Mich. N.	Mich. S.	Ohio.	Ind.	Ill.	Iowa.	Mo.	Other States.
Cardiopsis jejuna, Win.	Phil.Proc.,Sep. 1862,p.417		*						
" megambonata, Win,	" " 417	*					*		
" radiata, M. & W.	" Oct. 1860: Ill. Rep., II., 157				*	*			
=*Megambonia Lyoni*, Hall	xiii. Rep. N.Y.Reg. p. 110								
Cypricardella quadrata, W. & W.	Bos. Proc., viii., 300						*		
" Barquensis, Win.	MS.	*						*	
Cardinia occidentalis, Swal.	St. Louis Trans., I., 655								
Sanguinolaria leptogaster, Win.	Phil.Proc., Jan. 1863,p. 18						*		
" rostrata, Win.	" July 1865, p.129		*						
" sectoralis, Win.	" Sep. 1862, p. 422		*						
" septentrionalis, Win.	" " 421		*						
" similis, Win.	" " 421		*						
Anatina Leda, Hall	xiii. Rep. N.Y. Reg. p.110				*				
Solen Missouriensis, Swal.	St. Louis Trans., I., 655							?	
" quadrangularis, Win.	Phil.Proc.,Sep. 1862,p.422		*	*					
" scalpriformis, Win.	" " 422		*						Tenn
Conularia Byblis, White	Bos. Proc., ix., 22						*		Tenn
" multicostata, M. & W.	Phil.Proc.,Dec.1865,p.252			*					
" Newberryi, Win.	" Jan. 1865, p. 130			*					
" Whitei, M. & W.	" Dec. 1865, p.253			*					
" sp ?	Mo. Rep., 218							*	
Bellerophon Barquensis, Win.	Phil. Proc., Sep. 1862, 427	*							
" bilabiatus, W. & W.	Bos. Proc., viii., 304			*			*	*	
" cyrtolites, Hall	xiii. Rep.N.Y. Reg., 107: Win. Phil. Proc.,Sep.1862 p. 426; Ill. Rep. II., 160		*	*	*		*		
" galericulatus, Win.	Phil.Proc.,Sep. 1862,p.426		*						
" lineolatus, Hall	xiii. Rep. N. Y. Reg., 107		*		*				
" Michiganensis, Win.	Phil.Proc.,Sep. 1862,p.427		*						
" nautiloides, Win.	" " 427		*						
" panneus, White	Bos. Proc., ix., 21						*		
" perelegans, W. & W.	" viii., 304						*		
" rugosisculis, Win.	Phil.Proc.,Sep. 1862,p.425		*						
" scriptiferus, White	Bos. Proc., ix., 21						*		
" vinculatus, W. & W.	" viii., 304			*			*		
" Whittleseyi, Win.	Phil.Proc.July 1865, p.130						*		
Porcellia crassinoda, W. & W.	Bos. Proc., viii., 303								
" nodosa, Hall	Iowa Rep. Sup.to Vol. I,p. 4; Ill. Rep., III., 458					*			
" obliquinoda, White	Bos. Proc., ix., 21						*		
" rectinoda, Win.	Phil.Proc.,Jan. 1863, p.18						*		
Pugiunculus? (Theca) aculeatus,Hall	xiii. Rep. N. Y. Reg., 107		*		*				
Dentalium grandævum, Win.	Phil. Proc.,Jan. 1863,p.18						*		
" (?) Barquense, Win.	" Sep. 1862, p. 425	*					*		
Metoptoma undata, Win.	" July 1865, p. 131						*		
Platyceras æquilaterale, Hall	Iowa Rep., Supp.					*			
" bivolve, W. & W.	Bos. Proc., viii., 302			*			*		
" corniforme, Win.	Phil.Proc.,Jan. 1863, p.18						*		
" haliotoides, M. & W.	" 1866, p. 264; Ill. Rep., III., 458			*					
" Herzeri, Win.	Proc.A.P.Soc.,Jan., 1870, p. 256			*					
" paralium, W. & W.	Bos. Proc., viii., 302			*			*	*	
" vomerium, Win.	Phil.Proc.,Jan. 1863, p.19			*			*		
" (Orthonychia) subplicatum, M. & W.	" 1866, p. 265; Ill. Rep., III., 457			*					
Pleurotomaria exigua, Win.	" Sep. 1862, p. 424		*						
" Hickmanensis, Win.	Proc.A. P. Soc.,xii.,p. 257								Tenn
" humilis, Win.	Phil.Proc.,Sep. 1862,p.424		*						
" Mississippiensis,W.&W.	Bos. Proc., viii., 302						*		
" (?) mitigata, Hall	xiii. Rep N. Y. Reg., 108				*				
" quinquesulcata, Win.	Phil.Proc.,July 1865,p.131						*		
" rota, Win.	" Jan. 1863, p. 19						*		
" Stella, Win.	" Sep. 1862, p. 424		*						
" tectoria, Win.	" Jan. 1863, p. 19						*		
" vadosa, Hall	xiii. Rep. N.Y. Reg., 108 Win. Phil. Proc., Sep. 1862, p. 423		*	*	*				
" Whitei, Win.	Phil.Proc. Sep. 1862,p.423		*						
Murchisonia (Pleurotomaria ?) limitaris, Hall	xiii. Rep. N.Y. Reg. p.108				*				

NAMES,	References.	Mich. N.	Mich. S.	Ohio.	Ind.	Ill.	Iowa.	Mo.	Other States.
Murchisonia neglecta, Win.	Phil. Proc., Jan. 1863, p. 20						*		
" prolixa, W. & W.	Bos. Proc., viii., p. 303			*			*		
" quadricincta, Win.	Phil. Proc., Jan. 1863, p. 19			*			*		
" (?) Shumardiana, Win.	" " 20						*		
" sp?	Proc. A. P. Soc., xii., 260						*		Pa.
Straparollus Ammon, W. & W.	Bos. Proc., viii., 301								N. Y.
=*E. depressus*, Hall, sp. (not *E. depressus*, Sby.)	N. Y. Rep. 1Vth Dist., p. 291						*		
" Barrisi, Win.	Phil. Proc., Jan. 1863, p. 20						*		
" cyclostomus, Hall, sp.	Iowa Rep., Part 2, p. 516								
" lens, Hall, sp.	xiii. Rep. N. Y. Reg. 109; Ill. Rep., II., 159				*	*		*	
" macromphalus, Win.	Phil. Proc., Jan. 1863, p. 20						*		
" obtusus, Hall, sp.	Iowa Rep., p. 523			*			*		
" spirorbis, Hall, sp.	xiii. Rep. N. Y. Reg. p. 107				*				
" sp?	Mo. Rep., 218							*	
Phanerotinus paradoxus, Win.	Phil. Proc., Jan. 1863, p. 21						*		
Holopea conica, Win.	" " 21						*		
" subconica, Win.	" " 21						*		
Machrochilus pinguis, Win.	" " 21						*		
Loxonema oligospira, Win.	" " 22						*		
" turritiformis, Hall	xiii. Rep. N. Y. Reg., 109				*			*	
Chemnitzia tenuilineata, Shum.	Mo. Rep., II., p. 20								
Holopella mira, Win.	Phil. Proc., Jan. 1863, p. 22						*		
Naticopsis depressus, Win.	" " 22						*		
?Orthoceras arcuatellum, Sand b.	Verstein. 165, Taf. xix. 2; Amer. Jour. Sci., [2], xxxiii., 355		*						
" Chemungense, Swal.	St. Louis Trans., I., 660							*	
" ciinocameratum, Win.	Am. Jour. Sci. [2] xxxiii., 356	*							
" heterocinctum, Win.	Phil. Proc., Jan. 1863, p. 23						*		
" Indianense, Hall	xiii. Rep. N. Y. Reg., 107 Win. Am. Jour. Sci. [2], xxxiii., 354		*	*	*		*		
" Lathropianum, Win.	Am. Jour. Sci. [2] xxxiii. 357		*						
" Marshallense, Win.	" " " 356		*						
" multicinctum, Win.	Phil. Proc., Sep. 1862, p. 421		*						
" occidentale, Win.	Am. Jour. Sci. [2] xxxiii. 356		*						
" reticulatum, Phil.	Geol. Yorks., II., 238 Win. Am. Jour. Sci. [2], xxxiii. 357		*						
" robustum, Win.	Am. Jour. Sci. [2], xxxiii. 356		*						
" vittatum (?) Sand b.	Verstein. 165, Taf. xx., 9; Win. Am. Jour. Sci. [2] xxxiii, 355		*						
" Whitei, Win.	Phil. Proc., Jan. 1863, p. 22						*		
" sp.	Mo. Rep., 218							*	
Gomphoceras sp?					*				
" "	Mo. Rep., 218							*	
" "	" 218							*	
Nautilus (Trematodiscus), altidorsalis, Win.	Phil. Proc., 1862, p. 429		*						
" " digonus, M. & W.	" Oct. 1860, p. 470; Ill. Rep., II., 163				*	*		*	
" " discoidalis, Win.	Am. Jour. Sci. [2], xxxiii. 360		*		?				
" " ingentior, Win.	" " " 361		*						
" " Meekianus, Win.	" " " 360		*						
" " planidorsalis, Win.	" " " 358		*						
" " striatulus, Win.	" " " 358		*						
" " strigatus, Win.	Phil. Proc., 1862, p. 426		*						
" " subsulcatus, Phil.	Geol. Yorks., II., 233 Win: Am. Jour. Sci. xxxiii., 361		*						
" " trigonus, Win.	Am. Jour. Sci. [2], xxxiii. 358		*						

Names.	References.	Mich. N.	Mich. S.	Ohio.	Ind.	Ill.	Iowa.	Mo.	Other States.
Nautilus (Trematodiscus) trisulcatus, M. & W.	Phil. Proc. Oct. 1860, p. 470; Ib. Jan. 1861; Ill. Rep., II., 162			*	*				
" (Gyroceras?) gracile, Hall, sp	xiii. Rep. N. Y. Reg., 105				*				
" sp?	Mo. Rep., 218							*	
Phragmoceras expansum, Win.	Phil. Proc., Jan. 1863, p. 23						*		
Cyrtoceras Rockfordense, Win.	" July 1865, p. 132				*				
=*N. (Cryptoceras) Rockfordense*, M. & W.	" " 275								
=*Gyroceras Rockfordense*, M. & W.	Ill. Rep., III., 459								
? " tesselatum, de Kon.	Anim. Foss., 529	*							
" unicorne, Win.	Phil. Proc., Jan. 1863, p. 23						*		
" sp?								*	
Gyroceras Burlingtonense, Owen	Rep. Wis., &c., p. 581						*		
Goniatites Allei, Win.	Am. Jour. Sci. [2] xxxiii., 363; Sketches of Creation, p. 116, fig. 50		*						
" Andrewsi, Win.	Proc. Am. Phil. Soc. xii. 259			*					
" Holmesi, Swal.	St. Louis Trans., I., 659							*	
" Houghtoni, Win.	Am. Jour. Sci. [2] xxxiii, 363		*						
" Ixion, Hall	xiii. Rep. N. Y. Reg., 100				*				
? =*G. rotatorius*, de Kon.									
" Lyoni, M. & W.	Phil. Proc. Oct. 1860, p. 471			*	*				
=*G. Hyas*, Hall	xiii. Rep. N. Y. Reg., 102								
" Marshallensis, Win.	Am. Jour. Sci. [2] xxxiii. 362	*	*	*					
" Morganensis, Swal.	St. Louis Trans., I., 659							*	
" Ohiensis, Win.	Proc. A. P. Soc., xii., 259			*					
" opimus, W. & W.	Bos. Proc. viii., 305						*		
" Osagensis, Swal.	St. Louis Trans., I., 659							*	
" Oweni, Hall	xiii. Rep. N. Y. Reg., 100	*			*				
" propinquus, Win.	Am. Jour. Sci., [2] xxxiii., 365	*							
" pygmæus, Win.	" " " 366		*						
" Romingeri, Win.	Phil. Proc., Sep. 1862, p. 427		*						
" Shumardianus, Win.	Am. Jour. Sci. [2] xxxiii., 363	*		*					
Proetus (Phillipsia?) auriculatus, Hall	xv. Rep. N. Y. Reg., 107			*					
" " ellipticus, M. & W.	Phil. Proc. Dec. 1865, p. 267; Ill. Rep., III., 460					*			
" " Missouriensis, Shum.	Mo. Rep., II., 196				*			*	
" " Swallovi, Shum.	" " " 196							*	
Phillipsia Doris, Win.	Phil. Proc. July 1865, p. 133				*	*			
=*Proetus Doris*, Hall	xiii. Rep. N. Y. Reg., 112								
" insignis, Win.	Phil. Proc. Jan. 1863, p. 24						*		
? " Maramecensis, Shum.	Mo. Rep., II., 199; Win. Phil. Proc., Jan. 1863, p. 24				*		*		
" Rockfordensis, Win.	Phil. Proc. July 1865, p. 133					*			
" Tennesseensis, Win.	Tenn. Rep. 1869, p. 445; Proc. A. P. Soc., xii., 259								Tenn
" sp?	Mo. Rep., 218							*	
Cythere crassimarginata, Win.	Phil. Proc. Sep. 1862, p. 429		*	*					
Helodus biformis, Newb. & Wor.	Ill. Rep., II., 77						*		
" placenta, Newb. & Wor.	" " 80						*		
Gyracanthus Alleni, Newb.				*					
Orodus multicarinatus, N. & W.	" " 62				*				
Pleurodictyum problematicum, Goldf.	Win.: Proc. A. P. Soc., xii., 260			*					

Note.—In the foregoing table, "Bos. Jour." = Journal Boston Soc. Nat. Hist.; "Bos. Proc." = Proceedings of same; "Ill. Rep.," "Iowa Rep.," "Mo. Rep." "N. Y. Rep.," "Tenn. Rep.," = Geological Reports of Illinois, Iowa, Missouri, New York IVth District, and Tennessee, respectively; "Mich. N." and "Mich. S." = Northern and Southern outcrops of Marshall group; "Pamph." = Pamphlet issued Nov. 1863, republished in xvii. Reg. Rep., p. 50; "Phil. Jour." = Journal Academy of Natural Sciences, Philadelphia; "Phil. Proc." = Proceedings of same; "Prelim. Notice" = Preliminary Notice, &c., Preparatory for the Palæontology of N. Y.; "Rep. N. Y. Reg." = Appendix to Annual Report Regents of University, State N. Y., on condition of State Cabinet; St. Louis Trans." = Transactions Acad. Sciences, St. Louis.

From the foregoing catalogue, it appears that the total number of determined species, from rocks of the period under consideration, is, at present, 416. These are distributed in groups as follows:

Plants,	9	Porcellia,	4
Corals (Polypi),	13	Gasteropoda,	48
Crinoidea, &c.,	27	Cephalopoda,	46
Fenestella,	1	Trilobites,	9
Brachiopoda,	124	Ostracoids,	1
Lamellibranchiata,	116	Fishes,	4
Bellerophon,	13	Pleurodictyum,	1
Total,	416		

The number of species known, but not identified, is 20.

The identified species have been collected in eleven detached districts or States, which have yielded, severally, the following numbers:

1. Northern Michigan	23
2. Southern Michigan	93
3. Ohio	139
4. Indiana	45
5. Illinois	27
6. Iowa	160
7. Missouri	77
8. Kentucky	2
9. Tennessee	13
10. New York	9
11. Pennsylvania	9
Total identifications	597

From this it appears there have been 181 identifications of species in two or more of the above regions. A further analysis of the geographical distribution of these species will set in a strong light the palæontological affinities of the several regions.

It might be admitted at once that the outcrop at Pt. aux Barques ("Northern Michigan") is of the same geological age as the typical formation in Southern Michigan; but as Messrs. Houghton and Hubbard[115] have separated the two series of outcrops as different formations, I desire to introduce the palæontological discussion, by setting at rest all controversy respecting the synchronism of the strata in the two Michigan districts. The following species occur in both regions:

Producta concentrica,	Ctenodonta sectoralis,
Rhynchonella Hubbardi,	" Stella,
Mytilus Whitfieldanus,	Goniatites Marshallensis.
Sanguinolites borealis,	

With 30 per cent. of the known species of the Pt. aux Barques sandstones identifiable with fossils from the Marshall sandstones, and with a

[115] See Part I. of this paper, p. 59.

stratigraphical and lithological conformity in the two series of sandstones (besides *Goniatites Oweni*, common to Northern Michigan and Indiana, *Chonetes Illinoisensis*, common to Northern Michigan, Ohio, Indiana and Iowa; *Cardiopsis megambonata*, common to Northern Michigan and Iowa, and *Goniatites Shumardanus*, common to Northern Michigan and Ohio), I think their geological equivalency can never hereafter be called in question.

In conducting the palæontological branch of the discussion of equivalencies among the western districts, it would be appropriate to cite here the lists of species identified in two or more of these districts. As this, however, would considerably extend the limits of this paper, and these lists are readily deducible from the "Catalogue" given, I present only the summaries. In doing this, I shall count the two Michigan districts as one, and shall also omit Kentucky, since I feel some uncertainty about the geological position of the two species recorded from that State.

Species common to	Michigan	and	Ohio,	27
"	"	"	Indiana,	9
"	"	"	Illinois,	1
"	"	"	Iowa,	13
"	"	"	Missouri,	3
"	"	"	Tennessee,	4
"	"	Ohio	and Indiana,	12
"	"	"	Illinois,	10
"	"	"	Iowa,	51
"	"	"	Missouri,	16
"	"	"	Tennessee,	4
"	"	Indiana	and Illinois,	5
"	"	"	Iowa,	7
"	"	"	Missouri,	5
"	"	"	Tennessee,	2
"	"	Illinois	and Iowa,	10
"	"	"	Missouri,	14
"	"	Iowa	and Missouri,	13
"	"	"	Tennessee,	5
"	"	three	States,	32
"	"	four	"	10
"	"	five	"	2

Should we unite *Producta Shumardana* and *P. pyxidata* with *P. concentrica*, the latter species would be known in seven different Western States, besides the Pt. aux Barques region.

With such an extended network of identifications, and with long lists of representative species which I forbear to cite, I believe it will be admitted that the several formations brought under comparison must have been accumulated in one geological period. Let it now be distinctly stated what are the formations which are thus synchronized. They are as follows :

1. The Marshall Group of Michigan.

2. The Gritstone and Waverly series of Ohio, down to the Chocolate Shales.

3. The Goniatite Limestone of southern Indiana, and its equivalent sandstone in northern Indiana.

4. The Kinderhook Group of Illinois.

5. The Yellow Sandstone series of Iowa, at least down to the bluish sandy shales.

6. The series known in Missouri as the Chouteau Limestone, the Vermicular Sandstone and Shale, and the Lithographic Limestone.

7. The Silico-bituminous Shales at the base of the Silicious Group of Tennessee.

For the sake of brevity and convenience I shall hereafter employ the term Marshall Group as the general designation for this formation in the Western States.

Let us next consider what are the paleontological relations subsisting between the Marshall Group and the Chemung and Portage and older formations of New York.

Professor Hall [116]has described from Summit County, Ohio, a crinoid under the name of *Forbesiocrinus communis*, which, he states, cannot be distinguished from a single specimen from the Chemung of Chatauque County, N. Y. At the same time he states that this species combines some of the characters of two types occurring in the Carboniferous Limestone. Another species, *Forbesiocrinus lobatus*, presents characters which he regards as constituting a variety (*Var. tardus*) of a species from the Hamilton Group[117]. A third species from the same locality, he regards as closely related to *Poteriocrinus diffusus*, of the Hamilton Group, though distinctly differing. At the same time Professor Hall notes no less than seven species from this locality which exhibit distinct affinities with species from the Burlington Limestone. We have in this assemblage of crinoids, therefore, two species identified with species from rocks which I regard as older than the Marshall, while nine species, including the two identified, sustain intimate relations with the fauna of the Carboniferous system, which Professor Hall assumes to be entirely above the zone of the Chemung.

The only other species from the Marshall Group which stand referred to strata as old as the Chemung are the following :

1. *Strophomena arctostriata* Hall, from Hobbieville, N. Y.,—doubtfully recognized at Cuyahoga Falls, Ohio.

2. *Orthis Vanuxemi*, Hall, which if not identical with *O. Michelini* L'Evéillé, a carboniferous species, is so closely related as to show that the type of *O. Michelini* began to exist during the Hamilton period. A species perhaps identical, has been described from Iowa as *O. Swallowi*, Hall; and *O. flava*, Win. from the same locality, belongs to the same group of forms.

[116] xvii, Rep. N. Y. Regents, p. 50.

[117] The analogue of this is *F. Giddingi*, of the Carboniferous Limestone. Hall, xv. Rep. N. Y. Reg. 124.

3. *Orthis resupinata* de Kon. ranges from the Devonian into the Carboniferous system both in Europe and America.

4. *Orthis Thiemei*, White, from Iowa, is reported by Professor Hall as identified in the Chemung of New York.

5. *Chonetes Logani* Nor, and Prat, is also reported by Professor Hall occurring in the Tully Limestone. I have heretofore expressed my dissent from this identification.[118] I pronounced the New York species distinct before being informed of its geological position or locality. It presents a series of concentric rugosities or wrinkles which extend both across the ribs and the intervals between the ribs, while in *C. Logani* the rugosities are feebler, and are confined to the crests of the ribs.

6. *Strophomena rhomboidalis*, Wahl, has a range even greater than that of *O. resupinata*.

7. *Spirifera mucronata* Con., found in the Chemung of Steuben County, N. Y., was doubtfully identified in Missouri. Not having seen the Missouri specimens, I would be strongly inclined to suspect that they belong rather to *S. extenuata*, or some related species.

8. *Ctenodonta bellatula*, Hall, sp. of the Hamilton group of New York, has also been doubtfully identified in Missouri.

A few additional species had been provisionally reported identical with Chemung forms, but as already stated, a direct comparison of the species suspected to be identical has induced me to abandon the identification in every instance. We have then no unquestioned identifications with species from rocks as old as the Chemung, except in the case of *Orthis resupinata* and *Strophomena rhomboidalis*, and perhaps *Orthis Thiemei*. It is fair to presume that the forms of *Strophomena rhomboidalis*, occurring as high as the Marshall group, will yet be distinguished from the Silurian forms by appreciable characters, as has been done recently in respect to the forms of *Atrypa reticularis*.[119] The different expression of the Marshall forms has already been remarked. This species, so abundant in the Marshall period, existed in the Lower Silurian, and appears to have attained its culmination in the Upper Silurian. There is an improbability that the same species, after having once undergone a decline, should attain a second culmination in seas swarming with species and types of a much later period.

I think it will be admitted that the paleontological correspondence between the Marshall and the Chemung strata is extremely meagre. We know four hundred and fifteen species from the strata of the Marshall period, of which 138 come from Ohio, a State almost in continuity with the State of New York. We know probably 100 or 150 species from the Chemung of New York; and yet we are able to identify scarcely a single characteristic species with the types of the Marshall group. This state of the facts looks very unfavorable to the attempt to parallelize the Marshall and Chemung.

I proceed now to point out the specific facts bearing upon the relation subsisting between the Marshall fauna and that of formations in Western

[118] Proc. Acad. Nat. Sci. Phil. July, 1865, p 116.

[119] Whitfield: observations on the internal appendages of the genus Atrypa, 1866.

New York, which are newer than the characteristic Chemung. I have already stated that Professor Hall indicates the existence in Western New York, of three conglomerates which he regards as coming in consecutively above the typical Chemung. I have also stated that the consecutive arrangement is not established by any observed superposition. On an examination of the fossils of the so-called carboniferous conglomerate preserved in Professor Hall's magnificent cabinet, I at once identified the following Marshall species :

Straparollus Ammon, White.[120]
Cypricardia contracta, Hall=(Edmondia bicarinata Win.)
Edmondia æquimarginalis, Win.
Allorisma Hannibalensis, Shum.

Straparollus Ammon is from Iowa, though an undistinguishable form occurs in the coal measures of Lasalle, Illinois. *Cypricardia contracta* is also from Burlington, while *Edmondia æquimarginalis* is known in Michigan, Ohio and Iowa, and has a European analogue in *Cardina robusta* of J. de C. Sowerby ; and *Allorisma Hannibalensis* is known in Michigan, Ohio,[121] Iowa and Missouri. The whole number of species in the cabinet from this conglomerate did not amount, if I remember rightly, to more than eight, and here were four of them immediately and conclusively identifiable. Here is a percentage of identifications forty or fifty times as great as we have been able to make with fossils of Chemung age. It seems to me that we are within the limits of truth when we assert that the paleontological evidence points much more strongly to a synchronism between the Marshall group and this conglomerate, than between the Marshall and the Chemung.

When next I turned my attention to an examination of specimens from the reputed Chemung conglomerate, I remarked its lithological similarity to the former, and was able also to recognize among the fossils the following species identified in the other conglomerate :

Edmondia æquimarginalis.
Allorisma Hannibalensis.

Out of a very limited number of fossils in these two conglomerates, here were two completely identical. But for their reputed dissimilarity in age, any paleontologist would feel inclined to pronounce them synchronous. Biding the opportunity to make a re-examination of the grounds upon which Professor Hall has separated these two conglomerates ; and holding paleontological induction as always subordinate to stratigraphical demonstration, I shall provisionally regard as one the two conglomerates under consideration.

The so-called Chemung conglomerate rests upon typical Chemung strata. The outliers of the Catskill group in Western New York also rest, when-

[120] This was described by Hall as *Euomphalus depressus*, but as this name had been preoccupied by Sowerby, the name of White will take precedence.

[121] This and some others of the species identified in this paper from Ohio have very recently been sent rom Licking County by Rev. H. Herzer. P. S.—Others have been sent by Prof. E. Andrews, See. Proc. A. P. Soc. xii, 245.

ever seen, upon Chemung strata, and so do the outliers of the so-called Carboniferous conglomerate. Not only are the three similarly superposed, but they agree in presenting sometimes a conglomeritic character, and sometimes the character of a sandstone with oblique lamination. The carboniferous conglomerate near Panama, in Chatauque County, affords a fine building stone, and is quarried there for that purpose. Finally, I desire to recall the fact that the Marshall sandstone in the vicinity of Pt. aux Barques assumes a decidedly conglomeritic character, and presents the appearance of the conglomerate at Cuyahoga Falls in Ohio, with which the earlier Michigan geologists were inclined to identify it. I ought also to mention the fact that *Cypricardia Catskillensis*, figured and described by Vanuxem,[122] presents close analogies with two species from the Marshall group, *Sanguinolites unioniformis* and *S. naiadiformis*.

For these reasons, I shall, for the present, regard the three conglomerates in Western New York, with the associated strata, as belonging together in the horizon of the Catskill group.

I ought to cite here the results of some investigations which I have more recently made upon a collection of fossils from the sandstones of Venango County, Pennsylvania.[123] At a point near Shafer's, on Oil Creek, the following characteristic fossils of the Marshall group were recognized in April, 1869, and the results communicated to Professor E. Andrews, to whom I was indebted for the specimens.

Lingula membranacea.	Hemipronites umbraculum.
Discina Gallaheri.	Orthis Michelini.
Producta semireticulata.	Spirifera Carteri.
Chonetes pulchella.	Syringothyris typa.
Hemipronites inæqualis.	

This locality was reported by Prof. Andrews to be "200 to 300 feet below the coal." Every identifiable specimen belonged to the Marshall group. Judging from these data, there can be no doubt that this group extends into western Pennsylvania.

At Kinzua, however, not far from Shafer's, at a point thought by Prof. Andrews to be a hundred feet lower, geologically, quite a different fauna presented itself. Not a single Marshall species could be identified; while *Spirifera disjuncta* (Phillips) Hall, and fragments of lamelli branches which seemed to belong to *Avicula longispina* and *acanthoptera* Hall, proclaimed the horizon of the Chemung.

Since the recognition of the Marshall sandstones in northwestern Pennsylvania,[124] it becomes much easier to admit the evidence which I have already adduced in proof of their existence in southwestern New York. The physical character of these sandstones so closely resembles that of the Chemung rocks that the line of demarkation between them had not

[122] Geol. Rep. Dist. N. Y., p. 186.

[123] Proc. Amer. Phil. Soc., Jan. 4*th*, 1870.

[124] Professor Hall, in xx Rep. N. Y, Reg. p. 295, reports also *Lepidechinus rarispinus* from Meadville, Pa., and Licking County, Ohio. He argues from this a parallelism which I will not contest, but the fact establishes no affinity with the Chemung.

heretofore been recognized in that part of the country. Further east, however, where they become lithologically differentiated from the Chemung, they had long since been assigned a distinct position, both in Pennsylvania and New York.

V. The Fauna of the Marshall Group presents a Carboniferous Aspect.

I proceed in the next place to prove, on paleontological grounds, that the Marshall group possesses close affinities with the carboniferous system. These affinities are manifested in the presence of species identical with recognized carboniferous fossils of America and Europe; in the presence of species which may be regarded as the precursors or analogues of recognized carboniferous fossils, and in the dominance of generic and sub-generic types which attain their culmination during the carboniferous age.

1. Species identified with fossils from the carboniferous rocks of America:

Producta semireticulata Flem.	Coal measures.
" Cora d'Orb.	" "
Chonetes Illinoisensis Wor.	
(=C. Logani Hall).	Burlington Limestone.
" multicosta Win.	" "
" mesoloba N&P.	Coal measures.
Hemipronites umbraculum Von Buch.	" "
Orthis Swallowi Hall,	Burlington Limestone.
Spirifera lineata? Phil.	Coal measures.
" Grimesi Hall.	Burlington Limestone.
" camerata Morton.	Coal measures.
Nuculana bellistriata Stev. sp.	Coal measures.
Phillipsia Maramecensis? Shum.	Warsaw Limestone.

2. Species which extend up into the base of the Burlington Limestone at Burlington, Iowa:

Syringopora Harveyi White.	Restricted.
Trematopora? vesiculosa Win.	"
" fragilis Win.	
Syringothyris typa Win.	Restricted.
Pentamerus lenticularis W&W.	
Aviculopecten Caroli Win.	
Pernopecten limatus Win.	Restricted.
Ctenodonta microdonta Win.	
Platyceras corniforme Win.	
Pleurotomaria rota Win.	
Orthoceras Indianense, Hall.	
" heterocinctum, Win.	

The species marked "restricted" do not occur below the base of the Burlington Limestone at Burlington, but they are included here because the fauna proper of the Burlington Limestone begins above the narrow

basal zone containing the Marshall species. *Syringothyris typa*, moreover, is believed to occur in the Kinderhook group of Illinois. [It is now known also from Ohio and Pennsylvania.]

3. Species identified with fossils from the Carboniferous rocks of Europe:

Producta semireticulata Flem.	Spirifera lineata? Phil.
? " Cora d' Orb.	Orthoceras reticulatum Phil.
Hemipronites unbracutum V. Buch.	Nautilus subsulcatus Phil.
Orthis Michelini L'Evé.	Cyrtoceras tesselatum de Kon.
" resupinata de Kon.	

4. Fossils whose analogues recur in the recognized carboniferous rocks of America:

	Analogues.
Platycrinus contritus.	Platycrinus Burlingtonensis.
Actinocrinus Helice.	Actinocrinus unicornis.
" pistilliformis.	Actinocrinus pyriformis. Actinocrinus pistillus.
" viminalis.	" Whitei.
Poteriocrinus Corycia.	Poteriocrinus cauliculus.
Forbesiocrinus lobatus Var. tardus.	Forbesiocrinus Giddingi.
Scaphiocrinus subcarinatus.	Scaphiocrinus carinatus.
" subtortuosus.	" tortuosus. " carinatus.
Zeacrinus paternus.	Zeacrinus scoparius.
Lepidechinus rarispinus.	Lepidechinus imbricatus.
Producta arcuata.	Producta semireticulata.
Producta Newberryi.	Producta semireticulata.
" morbilliana.	" Rogersi.
Chonetes multicosta.	Chonetes Logani.
Orthis Vanuxemi?	Orthis Michelini.
" flava.	" "
Spirifera hirta.	Spirifera pseudolineata.
" Cooperensis.	" lineata.
Spiriferina Clarksvillensis.	Spiriferina subtexta.
Spirigera Missouriensis.	Spirigera subtilita.
Pernopecten Shumardanus.	Pecten aviculatus.
Myalina Iowensis.	Myalina angulata.
Edmondia Burlingtonensis.	Edmondia radiata.
Sanguinolites Chouteauensis.	Cypricardia transversa.
Ctenodonta Stella.	Nucula ventricosa.
Conocardium pulchellum.	Conocardium carinatum.
Cypricardella quadrata.	Cypricardella subelliptica.
Bellerophon perelegans.	Bellerophon cancellatus.
Dentalium grandævum.	Dentalium venustum.
Platyceras paralium.	Platyceras acutirostre.
Straparollus Ammon.	Euomphalus Spergenensis
Macrocheilus pinguis.	Macrocheilus primigenius.

5. Fossils whose analogues recur in the Carboniferous rocks of Europe:

Producta arcuata,	Producta semireticulata.
" morbilliana.	" punctata,
Orthis flava.	Orthis Michelini.
Rhynchonella Sageriana.	R. pleurodon Var. Devrenxiana.
Rhynchonella Whitei.	Rhynchonella radialis.
" subcircularis.	" "
" persinuata.	" pleurodon.
" ? tetraptyx.	Spirifer Buchianus. [mis.
" Missouriensis.	Rhynchonella pugnax & reunifor-
Pterinea spinalata.	Avicula hunulata.
Pernopecten limæformis.	Pecten dissimilis.
Posidonomya Romingeri.	Posidonomya vetusta.
" mesambonata.	" "
Mytilus Whitfieldanus.	Modiola lingualis.
Myalina Michiganensis.	Myalina virgula.
" imbricaria.	" lamellosa.
Edmondia nitida.	Edmondia unioniformis.
" æquimarginalis.	Cardinia robusta.
" binumbonata.	Edmondia scalaris.
Sanguinolites concentrica.	Cardinia tellinaria.
Cardiomorpha modiolaris.	Cardiomorpha livida.
" Julia.	" Puzosiana.
Arca modesta.	Arca arguta.
Conocardium pulchellum.	Condocardium aliforme.
Bellerophon vinculatus.	Bellerophon bicarenus.
" rugosiusculus.	" decussatus.
" galericulatus.	" Urei.
Pleurotomaria humilis.	Pleurotomaria helicinoides.
Straparollus Ammon.	Euomphalus lævis.
Straparollus macromphalus.	Euomphalus lævis.
Orthoceras Indianense.	Orthoceras cinctum.
" robustum.	" giganteum.
" multicinctum.	" cinctum.
Nautilus trisulcatus.	Nautilus sulcatus.
" digonus.	" Edwardsianus, &c.
" planidorsalis.	" "
" trigonus &c.	" "
	" "
Cyrtoceras Rockfordense.	Cyrtoceras cyclostomum.
Goniatites Oweni.	Goniatites princeps.
" Ixion.	" rotatorius.
" Marshallensis.	" mixolobus &c.
" Lyoni.	" "
" pygmæus.	" striolatus.
" Romingeri.	" rotatorious.

6. Generic and sub-generic types of a carboniferous character. The most important genera possessing a paleontological value in this discussion are the following :

Actinocrinus.	Edmondia.
Producta .	Sanguinolites.
Aviculopecten.	Cardiomorpha.
Mytilus.	Nautilus.
Myalina.	Phillipsia.

The genus *Actinocrinus* begins its existence in the upper Silurian, but attains only a feeble development until we reach the lower carboniferous. It seems to reach its culmination in the Burlington Limestone. According to a table drawn up by Dr. B. F. Shumard[125] in 1865, this genus is represented by two species in the Niagara group, 2 in the Corniferous ; 6 in the Hamilton ; 3 in the Chemung ; 115 in the Burlington Limestone ; 29 in the Archimedes Limestone, and 2 in the Kaskaskia Limestone. Later investigations render it necessary to change these figures without materially altering their ratios. It is emphatically a Carboniferous genus. Of this genus seven or eight species are known in the Marshall group; and they also belong to those peculiar types which characterize the Carboniferous limestone (Compare for instance *A. pistilliformis*).

The genus *Producta*, in its sub-generic forms, has a similar history. It begins in the lower Devonian and culminates in the Lower Carboniferous. Professor Hall describes 11 species from the Chemung group of New York. I am acquainted with 20 species (including one *Strophalosia* ?), from the Marshall group. De Koninck describes 28 species from the carboniferous rocks of Belgium. D'Orbigny enumerates 63 known species of *Producta*,[126] of which one is Silurian, 4 are Devonian, and 49 are Carboniferous. Bronn enumerates[127] 45 species as certainly discriminated, of which 37 belong certainly to the Mountain Limestone, and only two occur in rocks as old as the Devonian.

Of the genus *Spiriferina* we have three species in the Marshall group. No species have ever been recognized in rocks as old as the Devonian.

The genus *Aviculopecten* is emphatically a Carboniferous type, and was so regarded by McCoy when first proposed. In his descriptions of British Paleozoic Fossils, he enumerates 18 species of the genus, 15 of which belong to the Carboniferous system, and 3 to the Old Red Sandstone. Nine species are reported from the Carboniferous rocks of Illinois. From the Marshall group I am acquainted with 12 species (including 4 species of *Pernopecten* not heretofore separated from *Aviculopecten*). It is true the Chemung contains also several species; but as the type is not known to descend lower, the presence of these species in the Chemung unites

[125] A catalogue of the Palaeozoic Fossils of North America I. Echinodermata.
[126] Prodrome de Paléontologie.
[127] Index Palæontologicus.

with the presence of *Productus* and various forms of land vegetation, in imparting to that group, to this extent, a Carboniferous aspect.[128]

The genus *Mytilus*, of which we know four species in the Marshall group, is decidedly one whose history runs through later geological times. Of 203 species enumerated by D'Orbigny, only 12 are recognized as occurring in rocks older than the Carboniferous, and it is probable that some of these belong to *Modiolopsis* and *Orthonota* or allied genera.

The genus *Myalina* was established by De Koninck exclusively to receive three species from the upper part of the Coal measures of Belgium. McCoy discovered none below the Permian system. In this country the genus is restricted to the limits of the Carboniferous system, attaining its maximum development in the Coal measures. Of this Carboniferous genus the Marshall group affords at least 5 species.

Edmondia, also founded for the reception of Carboniferous forms, has not been certainly traced downwards into the limits of the Devonian system. De Koninck gives two species, both from the Coal measures; Mc Coy, in the work cited, describes 10, all of which occur in the Carboniferous Limestone. The Marshall group has afforded 9 species which have been referred to this genus.

Sanguinolites of McCoy afforded its proposer 14 species, of which 11 occur in the Carboniferous strata, and 3 in rocks of older date. In the Marshall group we recognize 19 species of this genus, including 5 belonging to the type of *Cypricardia*.

The genus *Cardiomorpha* is, in the Old World, confined exclusively to the Carboniferous System, from which De Koninck describes 13 Belgian species, and McCoy 3 British species. We have described 5 species from the Marshall group, and know of none from the Chemung.

Nine species of trilobites have been described from the Marshall group, all of which probably belong to the Carboniferous genus *Phillipsia*, though five of them were referred to *Proëtus* by their original describers. Of the latter five, *Proëtus ellipticus*, M. & W. was thought by the authors to be probably a *Phillipsia*. *Proëtus Swallowi*, Shum. is regarded as the nearest analogue of this, and the latter is hence probably also a *Phillipsia*. This species, moreover, does not present the posterior termination of the great suture required by *Proëtus*. *Proëtus Doris*, Hall, was described from pygidia, and of course its generic relations are not demonstrated. I have since discovered from the same locality, several complete cephalic shields which present the distinctive marks of *Phillipsia*, so far as they have been pointed out. All the Carboniferous trilobites of Europe and America belong to this genus and its sub-genus *Griffithides*. Though Barrande inclines to recognize Phillipsia sparingly in the upper Silurian and Devonian, we are still compelled to regard it as an eminently Carboniferous type.

[128] As has been already intimated several Carboniferous types began their existence as early as the Hamilton and even the Corniferous period. Several of the *Fenestellidæ* from the Hamilton rocks of Michigan were identified by Dr. H. A. Prout with species in the Carboniferous Limestone. His work upon these fossils was incomplete at his death, and has never been published.

Of *Nautili* we are acquainted with 13 species from the Marshall group. Of these, 11 or 12 belong to the section characterized by longitudinal furrows and angulations and an open umbilicus, for which Messrs. Meek and Worthen have proposed the sub-generic name *Trematodiscus*.

Remarks similar to the foregoing could be offered in reference to the geological affinities of various other genera represented in the Marshall group—as *Platycrinus*, *Forbesiocrinus*, *Zeacrinus*, *Pterinea*, *Posidonomya*, *Pinna*, *Macrodon*, *Solen* and certain forms of *Spirifera*, *Bellerophon*, *Orthoceras* and *Goniatites*.

Such are the leading characteristics of the fauna of the Marshall group which indicate its affinities with the Carboniferous system of Europe and America.[129] To sum up: we find 12 species identified with fossils from the Carboniferous rocks of America; 12 species which extend from the Marshall strata upwards into the base of the Burlington Limestone at a point where the two formations rest in juxtaposition; 9 species identified with fossils from the Carboniferous rocks of Europe; 32 species whose analogues recur in the higher Carboniferous rocks of America; 44 species whose analogues recur in the Carboniferous rocks of Europe; 10 generic or sub-generic forms largely represented, which characterize pre-eminently the Carboniferous system, besides numerous other genera and species whose affinities point rather to Carboniferous than to other strata.

Two years ago, (Aug. 1866,) during the meeting of the American Association at Buffalo, a discussion incidentally arose as to the paleontological relations of the Marshall group, in which on the one hand, it was claimed that it presented "a Carboniferous aspect;" while on the other hand the question was asked, "what is meant by a Carboniferous aspect?" and the remark was added: "I don't know what you call a Carboniferous aspect." I turn now to the citation of facts, of which I have just presented a summary, and reply: "That is what I mean by a Carboniferous aspect."

To answer this question in other words, let me quote the language of a distinguished American paleontologist.[130] "We have a right to contend, therefore, for the existence of the Carboniferous system at any point where we can find a continuation of the genera *Pentremites*, *Productus*, *Goniatites*, (*Cyrtoceras*, *Discites*) *Nautilus* and the ganoid fishes.[131] I contend that this is the legitimate conclusion, or else the Carboniferous system is subordinate to the Devonian." That is in principle exactly what I contend for. It was in that school, too, that I received my teaching.

VI. The Fauna of the Chemung Group presents a Devonian Aspect.

In the further prosecution of this discussion it would be appropriate to

[129] The strata of the Marshall group probably correspond to the "yellow sandstone" of Ireland and the Westphalian schists lying at the base of the Carboniferous system.

[130] Hall: Foster & Whitney's Rep. Lake Sup. Land Dist II, 308.

[131] May we not say that the Devonian is distinguished from the Silurian by the *advent* of these and other types, while the Carboniferous is characterized by their great expansion?—this being indicated by the great multiplication of species, the increased richness of ornamentation, the extravagant development of certain features, and sometimes by unusual bulk. Carboniferous types in the Devonian Age were, in a sense, *prophetic faunas*, or "colonies"—to employ a phrase from Barrande, used in reference to the Primordial Zone of the environs of Prague.

enter upon an examination of the paleontological affinities of the Chemung group, with which it has been thought this Carboniferous assemblage of strata can be synchronized. I shall content myself, however, with three remarks. 1. The fauna of the Chemung group embraces numerous generic forms, some for the first time introduced, which were destined to undergo their full expansion and find their closest analogues in the Carboniferous Age. 2. It embraces some generic and many specific forms which lingered from early Devonian times, and which do not pass the upper limits of this group. 3. The balance of affinities is universally admitted to be with the Devonian system, so that the attempt to establish that proposition would be superfluous.

VII. Can the Marshall and Chemung be Synchronized?

Ever since Cuvier first enunciated the doctrine of successive faunas in the past history of the world, geologists have held that paleontological characters stand next in importance and reliability to observed superposition in the determination of the synchronism or sequence of formations. Pictet[132] lays down the following principles for our guidance in the use of fossils:

"1. In all countries which have been studied to the present time, the geological faunas succeed each other in the same order."

"2. Contemporaneous formations, or those formed at the same epoch, contain identical fossils."

"3. Reciprocally, formations which contain identical fossils are contemporaneous."

Professor Agassiz,[133] in writing of the "succession of animals and plants in geological time," says: "I cannot refrain from expressing my wonder at the puerility of the discussions in which some geologists allow themselves still to indulge, in the face of such a vast amount of well-digested facts as our science now possesses. They have hardly yet learned to see that there exists a definite order in the succession of these innumerable extinct beings, &c."

"One result stands now unquestioned; the existence during each geological era of an assemblage of animals and plants differing essentially for each period. And by period I mean those minor sub-divisions in the successive sets or beds of rocks which constitute the stratified crust of our globe, the number of which is daily increasing as our investigations become more extensive and more precise."[134]

Professor Hall,[135] in attempting to establish the distinctness of the two groups, Portage and Chemung, uses these words: "When we apply the test of organic remains, we find an equally, or even more strongly marked difference in the two groups; and, upon this alone, a distinction between the two should be made." In reporting upon the result of his examination

[132] Paléontologie, I. p 100.
[133] Contributions to the Natural History of the U. S., vol. 1, p. 93.
[134] Ib. p. 96.
[135] Geolog. Rep. IVth Dist. N. Y., p. 229.

of western formations in 1841, he states:[136] "This examination westward also afforded a good opportunity of testing the value of fossil characters, when applied to the same strata extending over wide tracts of country, and the results will be seen, as we proceed, to have been mostly satisfactory." On another occasion he used the following words:[137] "Every step in this research tends to convince us that the succession of strata, when clearly shown, furnishes conclusive proofs of the existence of a regular sequence among the earlier organisms;" Finally, in 1850, he employed this explicit and pertinent language:[138] "In distant and disconnected localities we are compelled to base our opinions of the equivalency of beds upon the organic remains which they contain."

Such citations could be made almost without limit, but it scarcely seems necessary to proceed. Every paleontological research proceeds upon the assumption of the truths of the fundamental principles which these extracts enunciate. On paleontological grounds Professor Hall undertook the identification of the western formations; on such grounds he asserted the Spergen Hill limestone to belong to the age of the Warsaw limestone; on such grounds Mr. Billings identified the Lower Helderberg group in Maine; on such grounds Barrande divides his Promodial Zone into distinct stages which he attempts to identify in other parts of the world; on such grounds Barrande confidently asserted, without even having placed foot upon American soil, that certain Trilobites described by Professor Hall from the town of Georgia, in Vermont, belonged to a much lower, stratigraphical position than had been assigned to them; and thus, while sitting in his study at Paris, confidently and successfully rectified the mistakes of field geologists in America working amongst the hills of northern New England.

It is evident that if we proceed according to the established principles of paleontological science, we shall be obliged to deny the contemporaneous origin of the rocks of the Marshall and Chemung groups. We shall be induced to leave the Chemung within the limits of the Devonian system where it has been placed by the nearly unanimous judgment of paleontologists; and to admit the Marshall group within the boundaries of the Carboniferous system according to the present nearly unanimous judgment of western geologists;[139] according to the opinions of the eminent European geologists who have investigated the question, and according also to views which were at one time shadowed forth by the present principal opponent of such views. De Verneuil[140] in alluding to certain representatives of the Marshall group, says: "As it [the Devonian system in New York] is principally composed of Schists and argillaceous sandstones which, as we have said, are lost and disappear in the West, it thence results that in the States of Ohio, Indiana and Kentucky, it is reduced to

[136] Trans. Assoc. Amer. Geol. p. 268.
[137] Paleont. N. Y., vol. I. Introd. p. xxxiii.
[138] Foster and Whitney's Rep. Lake Sup. Land Dis. II. p. 286.
[139] See the references made in the 2d section of this paper.
[140] See Amer. Jour. Soc. [2] v. 370.

the Black Schists which represent the Genesee Slate, and to a calcareous band which represents at once the Corniferous and Onondaga limestones and the Hamilton group of the State of New York."

In his comments upon this paper of de Verneuil, from which I just quoted, Professor Hall himself says:[141] "We know that *between* the Chemung group and the great Carboniferous Limestone of the West and southwest, there is an extensive formation of yellow sandstones and green shales and sandstones"—and, for the sake of enforcing a view which he then held, that even the Chemung strata ought to go into the Carboniferous system, he adds, "charged with fossils having a close analogy with those of the groups below." Still further in his tabular arrangement appended to his elaborate discussion on the "Parellelism of the Paleozoic Deposits of the United States and Europe,[142] he places the "Yellow sandstones and green shales of Ohio," not only above the Chemung, but above the shales and sandstones of the Catskill mountains."

In the presence of such facts and such testimony as have been cited, it becomes a question of curious interest upon what grounds the geological equivalency of the Chemung and Marshall can still be maintained. In a paper presented before the National Academy last summer (1867) at Hartford, and repeated before the American Association at Burlington, it was held that the Devonian fauna of the Chemung in its western extension becomes replaced by the Carboniferous fauna of the Marshall simply through the influence of *local conditions*. Geographical variations were pointed out in the nature of the deposits and the accompanying faunas, of the Trenton, Hudson River, Niagara and Hamilton groups, and it was maintained that the paleontological contrast between the Chemung and the Marshall is something of the same kind, and possessing no different significance. These views at Hartford, were endorsed by the high authority of Professor Agassiz.

The same views had been previously recorded by Professor Hall in the Fourth Volume of the Paleontology of New York,[143] as follows: "We have every reason to believe that, in those sedimentary formations between the Hamilton group and the Coal measures in the east, and between the same group and the Burlington (Carboniferous) limestone in the west, the Devonian aspect of the fauna, on the one hand, and the Carboniferous aspect on the other, are due, in a great degree, to geographical and physical conditions, and not to difference of age or chronological sequence of the beds containing the fossils."

Again, in a pamphlet "Notice"[144] of this volume, in alluding to the contrast between the faunas of the Chemung and Marshall groups, he uses these remarkable words:—"*The distinction between Devonian and Carboniferous faunas is based as often upon geographical as chronological relations.*"

[141] Amer. Jour. Sci. [2] v. 368, Note.

[142] Foster and Whitney Rep. L. Sup. Land Dis. II, Chap. xviii.

[143] pp. 252–257. See Notice of this volume, Trans. Amer. Phil. Soc., May, 1866, p. 246; also, Pamphlet, 1867.

[144] Notice of IVth volume Pal. N. Y., 1867, p. 5.

It seems to me that the doctrine asserting the influence of geographical and other physical conditions, is being carried entirely too far. That the organic beings which populated the earth in past ages must have been distributed in each period, in faunas geographically restricted, under laws identical with those which now determine the distribution of animals and plants, is a doctrine which every reflecting paleontologist has either asserted or implied.[145] It would be puerile, indeed, to attempt to draw a stratigraphical induction from paleontological data, without keeping in view the known laws of faunal circumscription. But it is a new and an unprecedented procedure for a geologist to attribute to physical conditions the characteristics which the common consent of all paleontologists has assigned to faunas which lived in different ages of the world. This is to recede to the platform of De Maillet and Lamarck; it is to yield the determination of the organic facies of a geological period to the chances of physical conditions, instead of the domination of an intelligent method of sequence and adaptation; it is to surrender the grand procession of organic forms through past time, to the moulding and determinative influence of the secular changes of the physical world; it is to turn our backs upon positions which have been so ably and so successfully defended by our great adopted naturalist; it is to drown the key-note of the celebrated "Essay on Classification" in the discord of transmutationism and materialism.

The following extract is from the celebrated paper of de Verneuil, to which allusion has so often been made:[146] "We have endeavored to prove that the first traces of organic life in countries the most remote, appear under forms nearly alike, at the base of the Silurian System; and that the same types, often the same species, are successively, and in parallel order, developed through the entire series of the paleozoic beds. If we have not succeeded in lifting the vail which still hides from us the cause of this grand phenomenon, perhaps, at least, our observations have demonstrated the insufficiency of those causes by which certain authors seek to explain it. They prove, in effect, that *the phenomenon itself is independent of the influences which the depths of seas exercise upon the distribution of animals;* for if, in certain countries, the Silurian deposits prove a deep sea, they have, on the contrary, in the State of New York, a littoral character. They prove, in fine, that, in its general character, it is equally independent of the upheavings which have affected the surface of the globe; for, from the eastern frontier of Russia even to Missouri—distant from, or near the lines of dislocation—in the horizontal beds as well as those which are disturbed, the law according to which it is accomplished appears to be uniform." "We do not pretend to say that the differences of depth in the seas had not already an influence upon the distribution of animals; it is to this circumstance, on the contrary, that we attribute the more or less local faunæ which we often discover in the paleozoic formation. *But these local faunæ always afford some species which connect them with the*

[145] See, with multitudes of others, the works of Lyell, Sharpe, Salter, de Verneuil, d'Orbigny, Pictet, and especially of Barrande and Agassiz.

[146] See Amer. Jour. Sci. [2], vii. 51.

epoch to which they belong. They are the exceptions, which do not derange the general symmetry."

Let us now examine, for a moment, the circumstances which afford a shadow of plausibility to the extraordinary dogma of the parallelism of the Chemung and Marshall groups. It is alleged first, that the fauna of the Chemung assumes gradually a less Devonian and more Carboniferous aspect, when traced westward within the limits of the State of New York, and that it is possible that the characters of the Marshall group would be reached in the prolongation of the Chemung through the Western States. This allegation must be considered in the light of the fact, that a great thickness and geographical extent of strata in eastern New York, which were, a few years since, regarded as belonging to the Catskill group, are now pronounced by Professor Hall and Col. Jewett to be really a part of the Chemung; and that strata which were formerly regarded as Chemung belong really to the Hamilton. Restoring to the Hamilton that which is its own, it cannot be otherwise than that the Chemung strata of eastern New York should present a more modern aspect than was once supposed. But let it be granted that even yet the Chemung presents a more Carboniferous aspect in western than eastern New York, it is not yet a Carboniferous fauna; it retains numerous Devonian types; it does not embrace a trio of species, if it does a single one, which reappear in central and eastern Ohio. All this is unprecedented in formations of the same age, at points but one or two hundred miles removed from each other.

In the next place, some local difference in the nature of the sediments is admitted to exist. The rocks of the Marshall group, both in Ohio and Michigan, embrace a bed which is somewhat calcareous; in southern Indiana they are known only by an aluminous limestone; in Illinois and Missouri they are, to a considerable extent, calcareous and argillaceous. On the other hand, it is notorious that the great mass of the Marshall group consists of olive, reddish and yellowish sandstones, and shaly sandstones, which can scarcely be distinguished from the strata of the Chemung. The rocks are identical, and so far as we have the means of judging, the physical conditions under which the sediments were accumulated, must have been extremely similar. We discern none of those changed conditions which are always present on the occurrence of a local fauna. And yet the two faunas are more distinct than those of the Portage and Hamilton—vastly more distinct than those of the Hudson River and Trenton groups. Such pretensions are not set up in reference to any other formation. *Lingula prima*, of the Potsdam group, is recognized in the coarse sandstones of New York and Minnesota, and the fine aluminous shales of Alabama. The western prolongation of the Hudson River group is stocked with the same *Rhynchonella increbescens*, *Orthis lynx*, *Strophomena alternata* and *Chætetes lycoperdon*, as the typical strata of eastern New York. The various physical conditions under which we find the Niagara group, present us uniformly with *Canyocrinus ornatus*, *Halysites catenularia*, *Favosites Gothlandica*, *Athyris nitida*, *Spirifera radiata*,

&c. So the Corniferous limestone holds several species which never fail to declare its identity; and the Hamilton group is traced by persistent and unmistakeable paleontological characters over an area two thousand miles in breadth—from eastern New York to the Rocky Mountains, and from Central Kentucky to the valley of Mackenzie's river. It is incredible that the fauna of the Chemung sandstones, without visible change in physical conditions, should have undergone a total transmutation in a distance less than 200 miles. Were the lithological characters of the Chemung and Marshall remarkably distinct, we should expect a marked variation in the faunas, even if contemporaneous. But we should still have detected a few identical species, and a strong correspondence in dominant ideas—as the Edmondias, Aviculopectens and Producti, of the Chouteau limestone, are identical with the same genera and species of the Marshall sandstone. In some portion of the hundreds of thousands of square miles over which the Marshall strata have been extended, would have existed physical conditions sufficiently similar to those of New York, to have permitted the introduction of a few of the types which are dominant at the East.

The facts which I have already pointed out demonstrate that there *was* a time when the fauna of Ohio and Michigan had a representation in New York and Pennsylvania. Fossils even from Iowa and Missouri—fossils from fine, and even from calcareous strata—have been identified in western New York, identified, too, in conglomeritic deposits. It is even true, as de Verneuil asserts, that there is a law, however inscrutable, which stamps a common and recognizable impress upon faunas of the same age, however diverse the physical conditions under which they subsist.

The doctrine of faunal collocations of organic beings is founded in Nature, and has been made a specialty by one whose name commands universal respect. We must apply this doctrine to the distribution of extinct animals. It seems to me, however, there is a possibility of using this doctrine as "a hobby," and of carrying it to unwarranted limits. Thinking has its fashions no less than architecture and dress. Another fashion of our times is to reunite varieties and species of organic remains, which have been discriminated often with much study and great utility. It is the fashion just now to concede a wide range to the variability of species. Both these fashions tend to a relaxation of the rigor of the limits which we had set to the influence of external agencies. It seems to me that the true philosophy leads to the practice of a judicious conservatism in reference to the long-accepted canons of paleontological science.

For these reasons I cannot, at present, consent to the parallelizing of the Chemung and Marshall groups.

VIII. Parallelism of the Catskill and Marshall.

If the Chemung be not the eastern representative of the Marshall, where, it may be asked, does that representative exist? It would be no reply to the argument which I have presented, if no representation of the Marshall were yet discovered east of Ohio. The case would not be with-

out parallel. The St. Peter's Sandstone, the Galena Limestone, the Mountain Limestone, the Laramie Limestone, are all without distinct representation at the east. The Medina Sandstone, the Oriskany Sandstone, the Schoharie Grit, and the Marcellus Shale, are without distinct representation at the west. But it seems to me that, for the Marshall group, we have discovered a probable representative in the Catskill group of New York. The lithological and paleontological facts which favor this identification have already been pointed out. If this identification be correct, it will appear that the Catskill group is not to be regarded as thinning and partially disappearing, in central and western New York, in consequence of an original lack of sediments, but in consequence of subsequent denudation upon a scale of vast magnitude.

But it may be pronounced a fatal objection to this method of paralellizing, that the Catskill is regarded by the New York geologists, and by others, as the American representative of the Old Red Sandstone, which is generally admitted to be Devonian. In reply to this, I offer two suggestions. First, it is not the universal opinion of European geologists that the Old Red Sandstone, as restricted to Scottish deposits along the flanks of the Grampians, and upon the southern borders of the Moray Firth, is properly classed with Devonian strata. The North Devon strata, to which the term Old Red Sandstone has been extended, are thought by some to hold a lower position. The Scottish Old Red Sandstone may be, in part, at least, of Carboniferous age. Secondly, the identification of the Catskill with the Old Red, rests upon the similarity of a few scales of fishes, especially of a supposed *Holoptychius*. But fish remains are quite abundant in the Marshall group, and some of them of types similar to those of the Old Red. Dr. Newberry has described three species from Illinois. Moreover, the Molluscous fauna presents numerous affiliations with the fauna of the Old Red, as delineated in Murchison's Silurian System; and this resemblance, in fact, was the first circumstance which turned my attention to the equivalency proposed in this paper. Among Marshall fossils which I have noted as having near analogues in the Old Red of Scotland, are the following:

	Analogues.
Ctenodonta Iowensis, W. & W.	Cucullæa antiqua, Sow.
Isocardia ? Jennæ, Win.	Goniophora cymbæformis.
Murchisonia quadricincta, Win.	Turritella obsoleta.
Holopella mira, Win.	" gregaria.

Finally, it may be observed, that, whether the Catskill be synchronized with the Old Red or not, it holds a position above all the typical Devonian rocks of Europe and America. Professor Hall[147] long ago stated that "after the change which takes place at the termination of the Hudson River group, there is, perhaps, nowhere else in the Paleozoic series so complete a change in the lithological and Paleozoic features of the strata as at the termination of the Chemung group. Over a considerable extent

[147] Amer. Jour. Sci., [2] v. 367, Note.

in New York and Pennsylvania, the Chemung group is succeeded by a coarse sandstone or conglomerate, which lies at the base of the Red sandstone. This change is equally great with that which took place at the production of the Oneida conglomerate, and the mass forms a distinct topographical feature in the southern part of New York, and in parts of Pennsylvania. At the same time, all the peculiar organic forms of the Chemung group have become extinct. * * * When we undertake to mark the limits between systems, at points where it is difficult to decide them either from lithological or organic characters, (as in the separation of Devonian and Silurian,) it seems to us very proper to give more importance to such a remarkable line of separation as that indicated at the base of the red sandstone. * * * The relations between the red sandstone and the Carboniferous system appear to be scarcely known at all; or whether there may, or not, be a more intimate relation between this mass and the succeeding gray sandstones, has never been shown."

M. de Verneuil,[148] while admitting it incontestible that the Catskill group "is upon the same horizon as the Old Red Sandstone of Scotland and Wales," concludes, with emphasis, that the study of the New York strata has resulted in "proving that the Old Red Sandstone, in America, is more recent than the schists and limestones which represent the deposits of the Eifel, the Hartz and of Devonshire."

In accordance with the views set forth in the foregoing paper, I append the following table of geological equivalents. The Table, as originally presented to the American Association, was published in the "Geology of Tennessee," pp. 364–5. As here given, it is slightly modified, in the Tennessee column, to adapt it to late discoveries already announced. In the Michigan column, I have merged the "Black shale" with the "Huron group," in accordance with views long entertained (see especially, Proc. Am. Phil. Soc., No. 81). That this shale occupies a position beneath the Hamilton will not, I think, be longer maintained. Whether it be wholly Genesee, or wholly Portage, or the representative of both, it is certainly a lower constituent of a group of argillaceous strata, which is one mass, physically, and which, in 1861, I was induced to designate as the "Huron Group," in consequence of its extensive outcropping around the shores of Lake Huron, between Detroit and Pt. aux Barques.

Hamilton Gr.	Hamilton Gr.	Hamilton Gr.	Hamilton Gr.	Hamilton Gr.	Hamilton Gr.	Hamilton Gr.	Hamilton Gr.	Hamilton Gr.	Hamilton Gr.	Hamilton Gr.	(Wanting)	Orthoceras-schiefer. Spiriferen sandstein. (Nassau.)
Genesee shale,	Hamilton shale.	*Black Shal. (perhaps Portage in part.)*	Black Shale.	Black Shale.	Black Shale?					Black Shale.	Black Shale.	
Cashaqua shale.		*Green Shal.*	*(Base of Waverly Series.)*									

[148] See Amer. Jour. Sci., [2] v., pp. 367, 369.

Table of Geological Equivalents.

NEW YORK.	ONTARIO.	MICHIGAN.	OHIO.	INDIANA.	ILLINOIS.	IOWA.	MISSOURI.	KENTUCKY.	TENNESSEE.	EUROPE.
(Wanting?)	(Wanting)	Parma Congl.	Conglom'ate.	Conglom'ate.	Conglom'ate.	?	?	Conglom'ate.	Conglom'ate.	MillstoneGrit
(Wanting)	(Wanting)	(Wanting)	False Coal Meas.	?	False Coal Meas.	?	?	False Coal Meas.	False Coal Meas.	?
(Wanting)	(Wanting)	Carboniferous Limest. Michigan Salt Gr.	(Wanting)	(Wanting)	Kaskaskia Li.	Kaskaskia L.	?	Kaskaskia L.	Kaskaskia L.	Mountain Limest.
				St. Louis Lim.	St. Louis Lim.	St. Louis Lim.	St. Louis Lim.	St. Louis Lim.	St. Louis L.	
				Warsaw Lim.	Warsaw Lim.	Warsaw Lim.	Warsaw Lim.	?	Warsaw L.	
				Keokuk Limestone. *Gray Lim. Brown Sh. Knobstones*	Keokuk Lim.	Keokuk Lim.	Keokuk Lim.	Keokuk Lim. *Knobstones*	Keokuk L.	
				?	Burlington L.	Burlington L.	Burlington L.	?	?	
Upper part of Catskill Gr. *including "Carboniferous" Conglomerate and "Chemung" conglomer'te*	(Wanting?)	Marshall Group.	Waverly Series. *in part.*	Rockford Limest. and Williamsport Gritstone.	Kinderhook Group.	Yellow Sandstone Series.	Chouteau Limestone, Vermicular Sandst. and Shale, Lithographic Limestone.	(*Probably dark siliceous shale not yet observed.*)	Siliceous Group. Siliceous Shales.	Old RedSand. (*Scotland.*) Yellow Sand. (*Ireland.*) Westphalian Schists.
Chemung Gr.	"Portage Shales."	Huron Group *Micaceous Schists and Flags.*	Chocolate Shale Series,	(Wanting)	(Wanting)	*Perhaps Lower part of Yellow Sandstone series.*	Bluish Shale	Argillaceous Beds.	(Wanting)	Cypridinenschiefer.
Portage Gr.		*Argillaceous Shale.*								

IX. The Name.

Should the equivalencies of the rocks under consideration be finally adjusted in the manner which I have indicated, it will be important to select a designation for the group in accordance with the recognized canons of geological nomenclature. In that case, it will scarcely be permissible to employ the term "Catskill Group," since the principal mass of the rocks which are made the type of that group is now known to belong to the Chemung; and the name would be a misnomer. A similar objection rests against the use of the term "Waverly." This term, as I have already intimated, has been used in different senses; and by all parties, from Professor Briggs down, has been employed to embrace, at least in central and southern Ohio (the typical region), either the entire series of strata between the Conglomerate and the "Black Shale," or, at least, the *lower portion* of that series. It is necessary to apply a term to the exclusion of the "Chocolate Series" of Ohio, underlying the fossiliferous sandstones of the Waverly series. The first geographical designation which was employed in this restricted sense was "Marshall Group," first employed and published by me in December, 1860, and afterwards introduced in my Geological Report, advance copies of which were distributed in August, 1861.

APPENDIX.

References to Publications on the Geology of the Rocks under Consideration.

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1838. Houghton: First Ann. Rep. Geol. Surv. Mich., p. 3.
" Briggs: First Ann. Rep. Geol. Surv. Ohio, p. 79.
" Foster: Second Ann. Rep. Geol. Surv. Ohio, p. 105.
1839. Houghton: Second Ann. Rep. Geol. Surv. Mich., p. 28.
1840. Hubbard: Mich. Geol. Rep., p. 87.
1841. Hubbard: Mich. Geol. Rep., p. 132, &c.
1842. Hall: Am. Jour. Sci. and Arts, xlii., p. 51.
" Hall: Jour. Bos. Soc. Nat. Hist., v., p. 1.
" Conrad: Jour. Acad. Nat. Sci., Phil.; viii., 249.
" Hall: Trans. Assoc. Amer. Geol., p. 269.
" Vanuxem: Final Rep. Geol. N. Y. IIId Dist.
1843. Hall: Final Rep. IVth Dist. N. Y.
1846. Hall: Paleont. N. Y., vol. I., Introd., p. 16.
1847. Yandell and Shumard: Contributions to the Geology of Ky., p. 16.
" De Verneuil: Bull. Soc. Geol. France, ser. II., Tome iv, p. 648 (Am. Jour. Sci. [2] v., 176, 350; and vii. 45, 218.)
1848. Sharpe: Quar. Jour. Geol. Soc. Lond., vol. iv, 151.
1848-9. Murray: Canad. Geol. Rep., p. 24.

1850. Hall: Foster & Whitney's Rep. L. Sup. L. Dist., II., p. 285.
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" Whittlesey. Ib., 207.
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1855. Swallow: Mo. Geol. Rep., I., 101.
" Marcou: Geol. Karte der Verin. Staaten, Peterm. Mittheil, p. 149.
" Shumard (B. F.): Mo. Geol. Rep., II., 137, 185.
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" Norwood & Pratten: Jour. Acad. Nat. Sci. Phil. [2] III., 254.
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" Safford: Geol. Reconn. Tenn., 158.
" Murray: Can. Geol. Rep., 1853–6, p. 129.
1858. Stevens: Am. Jour. Sci., [2] xxv., 262.
" Marcou: Geology of North America, &c., Zurich.
" Hall: Io. Geol. Rep. [I] 88, and [II] 517.
" Owen (D. D.): Geol. Recon. Ark., I., 87, &c., 135.
1859. Newberry: Ohio Agricultural Rep. 1859, Pamphlet on the Rock Oils of Ohio, p. 6.
1860. White: Jour. Bos. Soc. N. Hist., vii., 209, Sep.
" Lyon: Trans. St. Louis Acad. Nat. Sci., I., 620.
" Worthen: Ib., 571.
" Swallow: Ib., 635.
" Meek and Worthen: Proc. Acad. Nat. Sci. Phil.; Sep., p. 447.
" Winchell: Detroit Tribune, Dec. 11 (Summary of Results of Mich. Surv.)
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" Meek and Worthen: Amer. Jour. Sci. [2] xxxii.; 167 (Sep).
" Hall: xiii. Rep. N. Y. Reg., 96.
1862. White and Whitfield: Proc. Bos. Soc.; viii., 289 (Feb).
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" Winchell: Amer. Jour. Sci. [2] xxxiii., 352 (May).
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" Hall: xv. Rep. N. Y. Regents, 107 (Nov).
" Jewett: xv. Rep. N. Y. Regents, 198; and Amer. Jour. Sci., [2], xxxiv., 418.
" Hall: xv. Rep. N. Y. Regents, 81.
" Dawson: Quar. Jour. Geol. Soc. Lond., xviii.
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1863. Winchell: Proc. Acad. Nat. Sci., Phil., Jan., p. 3.
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" Winchell: Proc. Amer. Phil. Soc., xi., pp. 57–83.
" Newberry: Proc. Amer. Assoc. Salem Meeting, Relations of Ohio Geology to that of adjoining States.
1870. Hall: Preliminary Notice, &c., Preparatory for Palæntology of New York (received Jan).
" Winchell: Proc. Amer. Phil. Soc., xii., pp. 245–261 (read Jan. 4th).
" Newberry: Geological Survey of Ohio, its Progress in 1869. An Address before the Legislature (received 15 April).

ERRATA

IN PART I. OF THIS PAPER.

Page 57. Contents, v. for "analogies," read "analogues."
57. " ix., for "Their names," read "The Name."
64. Sixth line from top, for "*Gryroceras*," read "*Gyroceras*."
66. Tenth line from top, for "Hudson," read "Huron."
69. Note "70," line 3, for "authority," read "authorities."
72. Seventh line from top, for "correction," read "conviction."
72. Note "83," line 3. for "he previously," read "he had previously."
78. Note "104," line 2, for "geological," read "geographical."
80. Note "108," line 3, for "announcement," read "announcements."
82. Twenty-seventh line from top, for "phenomenon," read "phenomena."

Several minor errors will, perhaps, be apparent to the reader.